

## Occurrence of Iodo-Acid and Iodo-THM Disinfection By-Products in Chloraminated Drinking Water

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As part of a recent nationwide Disinfection By-Product (DBP) Occurrence Study, iodo-acids were identified for the first time as DBPs in drinking water disinfected with chloramines. The iodo-acids identified included iodoacetic acid, bromiodoacetic acid, (*E*)-3-bromo-3-iodo-propenoic acid, (*Z*)-3-bromo-3-iodo-propenoic acid, and (*E*)-2-iodo-3-methylbutenedioic acid. These identifications were confirmed using authentic chemical standards, both commercial (for iodoacetic acid) and synthesized (for the other four iodo-acids). There is concern about these new iodo-acid DBPs because mammalian cell cytotoxicity and genotoxicity studies have revealed that iodoacetic acid is highly cytotoxic and genotoxic, with a genotoxicity potency 2 times higher than bromoacetic acid, the most genotoxic of the regulated haloacetic acids. Also, many drinking water treatment plants in the United States have switched from chlorine to chloramines for treatment. New evidence indicates that the formation of iodinated DBPs will be higher in chloraminated drinking water than in chlorinated drinking water.

The goal of this work was to develop an analytical method to quantify these five iodo-acids in drinking water, measure their occurrence in several drinking waters treated with chloramination, determine whether they are maximized in waters treated with chloramines only (compared with chlorine and chlorine-chloramines), and investigate the mammalian cell cytotoxicity and genotoxicity of the four synthesized iodo-acids (beyond iodoacetic acid). Two iodinated trihalomethanes (iodo-THMs), dichloriodomethane and bromochloriodomethane, were also measured in these waters. These iodo-THMs were the most commonly found iodo-THMs in the previous nationwide DBP Occurrence Study. An analytical method similar to EPA Method 552.3 was developed to extract and quantify iodo-acid concentrations in drinking water samples. The first method applied used tert-amyl methyl ether for liquid-liquid extraction (after acidifying the water samples) and sulfuric acid/methanol for derivatization. Later, recoveries were improved by using ethyl acetate for extraction and salting out with sodium sulfate prior to extraction. Gas chromatography/mass spectrometry (GC/MS) with negative chemical ionization was found to offer the lowest detection limits of the detection techniques investigated (low and sub-ng/L for a 1-L water sample). Iodo-THMs were extracted using solid-phase microextraction and were analyzed using GC with high-resolution electron ionization-MS and stable isotope dilution (deuterated standards of each analyte).

Two samplings have been conducted to date on drinking water plants using chloramination. The first took place in May 2005 (of five plants), and the second took place in the fall of 2005 (21 plants). Iodoacetic acid and bromiodoacetic acid were found in most of the plants sampled, at sub-ppb to low ppb levels. (*E*)-2-iodo-3-methylbutenedioic acid was also found in many of the plants, and (*E*)-3-bromo-3-iodo-propenoic acid and (*Z*)-3-bromo-3-iodo-propenoic acid were found in a few of the plants sampled at sub-ppb levels. The two iodo-THMs sampled, dichloriodomethane and bromochloriodomethane, were found at all plants sampled, at low ppb or sub-ppb levels (with a high of 10.2 ppb for bromochloriodomethane).

*Notice: Although this work was reviewed by EPA and approved for publication, it may not necessarily reflect official Agency policy.*

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